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fluorine-based film (12) can be formed by applying a fluorine-containing solution (120) on the surface-smoothing layer (11, 13, 14), and by drying the fluorine-containing solution (120). The coating structure (1, E) can be suitably used for a fuel injection nozzle (7).

A cross-sectional view of a multi-layered material structure, designated by the numeral 1. The structure consists of several distinct layers. At the top is a thin layer with a cross-hatched pattern, labeled 12. Below this is a thick layer with diagonal hatching sloping from the top-left to the bottom-right, labeled 11. Underneath layer 11 is a thin layer with a horizontal hatching pattern, labeled 14. Below layer 14 is another thin layer with diagonal hatching sloping from the top-right to the bottom-left, labeled 13. The bottommost layer is a thick layer with diagonal hatching sloping from the top-left to the bottom-right, labeled 10. The entire structure is shown in a rectangular cross-section with a wavy bottom edge.



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# EUROPEAN SEARCH REPORT

Application Number  
EP 07 10 7945

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 1 287 953 A1 (KAI R & D CT CO LTD [JP]) 5 March 2003 (2003-03-05) * paragraphs [0016], [0022], [0034]; figures 5c,5d *	1,14-22, 35-42	INV. C23C28/00 B29C49/60 C23C18/32 C23C22/34 B32B15/08 F02M59/00
X	WO 2006/030999 A (BUKWANG TECHNOLOGY CO LTD [KR]; YOO YONG-SANG [KR]) 23 March 2006 (2006-03-23) * example 3 *	1-13, 22-34	
Y	----- * example 3 *	43	
X	EP 0 453 633 A (NIPPON KOKAN KK [JP]) 30 October 1991 (1991-10-30) * figure 3; examples 1-8 *	1 2-13, 22-34	
A	----- * figure 3; examples 1-8 *		
X	US 2005/069237 A1 (MICKELSON JAMES E [US] ET AL) 31 March 2005 (2005-03-31) * paragraphs [0018] - [0027]; figures 4,5 *	1 2-13, 22-34	
A	----- * paragraphs [0018] - [0027]; figures 4,5 *		
X	US 5 725 907 A (OHMI TADAHIRO [JP] ET AL) 10 March 1998 (1998-03-10) * figures 11A,11B; example 7 *	1 2-42	TECHNICAL FIELDS SEARCHED (IPC) C23C B32B F02M
A	----- * figures 11A,11B; example 7 *		
X	JP 56 047926 A (HITACHI LTD) 30 April 1981 (1981-04-30) Patent Abstracts of Japan* figure 1 *	1 2-13, 22-34	
A	----- Patent Abstracts of Japan* figure 1 *		
X	US 2003/121158 A1 (CLIPSTONE COLIN [US] ET AL) 3 July 2003 (2003-07-03) * paragraphs [0005], [0009]; figure 1 *	1,22 14-21, 35-42	
A	----- * paragraphs [0005], [0009]; figure 1 *		
A	US 6 617 047 B1 (HUEFFER STEPHAN [DE] ET AL) 9 September 2003 (2003-09-09) * column 5, line 38 - line 41 *	1-13, 22-34	
	----- -/--		
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 19 November 2007	Examiner Juhart, Matjaz
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EPO FORM 1503 03.82 (P04C01)



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# EUROPEAN SEARCH REPORT

Application Number  
EP 07 10 7945

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	GB 2 277 139 A (TEIKOKU PISTON RING CO LTD [JP]) 19 October 1994 (1994-10-19) * figures 1,3 *	1-13, 22-34	
Y	----- US 2004/000601 A1 (NIWA YUTAKA [JP]) 1 January 2004 (2004-01-01)	43	
A	* paragraph [0037]; figure 1 *	44-49	
A	----- JP 57 045036 A (MITSUI TOATSU CHEMICALS) 13 March 1982 (1982-03-13) Patent Abstracts of Japan* figure 1 *	43-49	
A	----- WO 01/61182 A (CATERPILLAR INC [US]; DAM CHUONG Q [US]; LONG MICHAEL C [US]; SHAFER S) 23 August 2001 (2001-08-23) * claims 1-30 *	43-49	
			TECHNICAL FIELDS SEARCHED (IPC)
The present search report has been drawn up for all claims			
Place of search <b>Munich</b>		Date of completion of the search <b>19 November 2007</b>	Examiner <b>Juhart, Matjaz</b>
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EPO FORM 1503 03/02 (P04C01)

**CLAIMS INCURRING FEES**

The present European patent application comprised at the time of filing more than ten claims.

- ☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid, namely claim(s):
- ☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

**LACK OF UNITY OF INVENTION**

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

- ☒ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.
- ☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.
- ☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:
- ☐ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:



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**LACK OF UNITY OF INVENTION  
SHEET B**

Application Number

EP 07 10 7945

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-42

Coating structure and method for forming the same

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2. claims: 43-49

A fuel injection nozzle comprising the needle coated with a coating structure including a surface-smoothing layer and a fluorine-based film formed thereon

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**ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.**

EP 07 10 7945

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on  
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19-11-2007

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
EP 1287953	A1	05-03-2003	AU 6070301 A	17-12-2001
			DE 60107840 D1	20-01-2005
			DE 60107840 T2	22-12-2005
			WO 0194083 A1	13-12-2001
			JP 2001340672 A	11-12-2001
			US 2004099120 A1	27-05-2004
-----				
WO 2006030999	A	23-03-2006	NONE	
-----				
EP 0453633	A	30-10-1991	CA 2028951 A1	27-10-1991
			JP 4009499 A	14-01-1992
			US 5100739 A	31-03-1992
-----				
US 2005069237	A1	31-03-2005	NONE	
-----				
US 5725907	A	10-03-1998	NONE	
-----				
JP 56047926	A	30-04-1981	NONE	
-----				
US 2003121158	A1	03-07-2003	NONE	
-----				
US 6617047	B1	09-09-2003	AT 227360 T	15-11-2002
			AT 245210 T	15-08-2003
			AT 237006 T	15-04-2003
			CA 2358097 A1	13-07-2000
			CA 2358099 A1	13-07-2000
			CN 1332810 A	23-01-2002
			CN 1338008 A	27-02-2002
			CN 1636305 A	06-07-2005
			DE 19860526 A1	06-07-2000
			WO 0040773 A2	13-07-2000
			WO 0040774 A2	13-07-2000
			WO 0040775 A2	13-07-2000
			EP 1144724 A2	17-10-2001
			EP 1144725 A2	17-10-2001
			EP 1144723 A2	17-10-2001
			ES 2204184 T3	16-04-2004
			ES 2197710 T3	01-01-2004
			JP 2002534605 T	15-10-2002
			JP 2003511551 T	25-03-2003
			JP 2002534606 T	15-10-2002
			US 6509103 B1	21-01-2003
			US 6513581 B1	04-02-2003
-----				
GB 2277139	A	19-10-1994	JP 6300129 A	28-10-1994
-----				

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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ON EUROPEAN PATENT APPLICATION NO.**

EP 07 10 7945

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The members are as contained in the European Patent Office EDP file on  
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

19-11-2007

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2004000601 A1	01-01-2004	DE 10329062 A1	05-02-2004
		JP 2004028051 A	29-01-2004
JP 57045036 A	13-03-1982	JP 1455249 C	25-08-1988
		JP 63004496 B	29-01-1988
WO 0161182 A	23-08-2001	EP 1177375 A1	06-02-2002